

Electrical Safety Implementation Guide

Los Alamos National Laboratory

Laboratory Implementation Guide, LIG 402-600-01.2

Issue Date 12/24/96 (Revision Date: 06/5/2003)

Nonmandatory Document

1.0 INTRODUCTION

1.1 Overview

This Laboratory implementation guidance (LIG) document complements Laboratory Implementation Requirement (LIR 402-600-01, "Electrical Safety"). This revised LIG is effective on the date of issue, except when noted.

1.2 In This Document

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2.0 PURPOSE

The purpose of this LIG is to provide guidance for implementing Los Alamos National Laboratory's (LANL or the Laboratory) Electrical Safety Program, described in LIR 402-600-01, "Electrical Safety."

3.0 SCOPE

This guidance is provided for electrical workers, electrical safety officers, supervisors, and managers who implement the Electrical Safety Program requirements contained in LIR 402-600-01. Section 3 of the LIR provides a full statement of the scope and applicability of the Laboratory's Electrical Safety Program.

4.0 DEFINITIONS

This LIG uses the terminology defined in Section 4 of LIR 402-600-01, which provides definitions of acronyms, abbreviations, and terms.

5.0 PRECAUTIONS AND LIMITATIONS

The precautions and limitations that pertain to this LIG are the same as those described in Section 6 of LIR 402-600-01.

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6.0 GUIDANCE

6.1 Resolution of Issues

6.1.1 Application

Any qualified electrical worker may initiate the issue resolution process described in the flowchart in Attachment A. The purpose of the process is timely resolution of electrical safety issues addressed in LIR 402-600-01; Occupational Safety and Health Administration (OSHA) Standard 1910, Subpart S; OSHA Standard, 1926 Subpart K; the National Electrical Code; the National Electrical Safety Code; Chapter 7 of LANL's "Facility Engineering Manual"; and other applicable electrical codes and standards. The process uses the authority having jurisdiction (AHJ) hierarchy shown in Attachment A of LIR 402-600-01 to resolve disputed electrical safety issues. The process is also intended to help implement the 100% rule of Subsection 7.4.2 of LIR 402-600-01 by providing a method to formally dispute and resolve electrical safety issues. The "Issue Resolution Process" form in Attachment A is provided for electrical workers' use in initiating the process and tracking the progress of the issue to final resolution.

6.1.2 Resolution Process

Refer to the recommended flowchart in Attachment A.

- A qualified electrical worker initiates a question or concern by filling out the top part of the LANL Electrical Safety Program issue resolution process form (see Attachment A). The worker submits the form to the next higher level authority. For most workers, this is their group's electrical safety officer (ESO).
- The group ESO (or other authority) should resolve the issue and respond to the originator within 5 working days. If the issue is not resolved to the satisfaction of the initiator, the group ESO sends the issue resolution form to the division's ESO or ESH-5's electrical inspector, depending on whether the issue involves a LIR issue, a code issue (such as the NEC or NESC), or an OSHA requirement.
- The division ESO or the ESH-5 electrical inspector should resolve the issue and respond to the initiator within 5 working days. If the issue is not resolved to the satisfaction of the originator, the division ESO or the ESH-5 electrical inspector sends the issue resolution form to the chief ESO.
- The chief ESO should resolve the issue and respond to the initiator within 5 working days. If the issue is not resolved to the satisfaction of the originator, the chief ESO should send the issue resolution form to the Laboratory's Electrical Safety Committee (ESC).
- The ESC should acknowledge receipt of the issue within 3 working days and resolve the issue within 14 working days.

6.1.3 Resolution Process Tracking

Refer to the Issue Resolution Process form in Attachment A.

- The originator should fill out the top part of the issue resolution process form to describe the issue and provide a summary of facts.
- Each reviewer (group ESO, division ESO, ESH-5 electrical inspector, chief ESO, and ESC) should fill in his/her/its proposed resolution and applicable dates to track the status of the issue and provide feedback to the initiator.
- If the initiator is not satisfied with the resolution, he/she should forward the issue to the next level using a new form, including all previous information and proposed resolutions.

6.2 Electrical Hazard Assessment

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6.2.1 Electrical Shock

Electricity is one of the most commonly encountered hazards in any facility. Under normal conditions, safety features built into electrical equipment protect workers from shock. Nonetheless, accidents can occur in which contact with electricity results in serious injury or death.

Most electrical systems establish a voltage reference point by connecting a portion of the system to an earth ground. Because these systems use conductors that have electrical potential (voltage) with respect to ground, a shock hazard exists for workers who are in contact with the earth and exposed to the conductors. If a person comes in contact with a “live” (ungrounded) conductor while also in contact with a grounded object, he or she becomes part of the circuit, and current passes through his or her body.

The effects of electric current on the human body depend on many variables, including the following:

- circuit characteristics (current, resistance, frequency, and voltage);
- the contact resistance and internal resistance of the body;
- the current's pathway through the body (determined by contact location and internal body chemistry);
- the duration of contact; and
- the environmental conditions affecting the body's contact resistance.

The chest cavity and brain are the parts of the body most vulnerable to electric shock. Fatal ventricular fibrillation (cessation of the heart's rhythmic pumping action) can be initiated by a current flow of as little as several tens of milliamperes. Electrical shock can cause nearly instantaneous fatality from direct paralysis of the respiratory system, failure of rhythmic pumping action, or immediate heart stoppage. Severe injuries, such as deep internal burns, can occur, even if the current does not pass through vital organs or nerve center. Specific values for hazardous voltages and for hazardous current flow through the body are not completely reliable because of physiological differences between people.

6.2.2 Electrical Burns

Burns suffered in electrical accidents are of three basic types: electrical burns, arc burns, and thermal contact burns. In electrical burns, tissue damage (whether skin-deep or deeper) occurs because the body is unable to dissipate the heat from the current flow. Typically, electrical burns are slow to heal. Arc burns are caused by electric arcs and are similar to heat burns from high-temperature sources. Temperatures generated by electric arcs can melt nearby material, vaporize metal in close vicinity, and burn flesh and ignite clothing at distances of several meters, depending on the power level. Thermal contact burns are those that occur when skin comes into contact with the hot surfaces of overheated electric conductors.

6.2.3 Delayed Effects

Damage to the internal tissues may not be apparent immediately after contact with the current. Delayed swelling and irritation of internal tissues are possible. In addition, imperceptible heart arrhythmia can progress to total fibrillation. In some cases, workers have died 2 to 4 hours after what appeared to be a mild electrical shock. **Immediate medical attention may prevent death or minimize permanent injury—this is the primary reason for reporting electrical shock immediately.**

6.2.4 Other Hazards

Voltage sources that do not have dangerous current capabilities may not pose serious shock or burn

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hazards in themselves and, therefore, are often treated in a casual manner. However, low-voltage circuits are frequently used adjacent to lethal circuits, and even a minor shock can cause a worker to rebound into a lethal circuit. Such an involuntary reaction may also result in bruises, bone fractures, and even death from collisions or falls.

Electricity also poses other hazards. An arc is often created when a short-circuit occurs or current flow is interrupted. If the current involved is strong enough, the arc can cause injury or start a fire. Fires can also be started by overheated equipment or by conductors that carry too much current. Extremely high-energy arcs can cause an explosion that sends fragmented metal flying in all directions. Even low-energy arcs can cause violent explosions in explosive or combustible atmospheres.

Because R&D equipment is often unique, the hazards it presents are sometimes peculiar. An uncommon or one-of-a-kind design scheme complicates analyzing and identifying such hazards. For this reason, special efforts are often necessary to identify all of the potential hazards that may be present in an R&D equipment design. In addition to shock, determining electrical hazards should include identifying potential arcs, blasts, and thermal burns. Once these hazards have been identified, a risk mitigation plan should be developed. Personnel working on unique R&D equipment should be specifically qualified through documented on-the-job training (OJT) to work on such equipment. The scope of such additional training depends on the unique safety problems inherent in the equipment.

6.2.5 Implementing Electrical Hazard Assessment

Electrical work at the Laboratory has been categorized to help qualified workers, qualified managers, designated supervisors, and ESOs select appropriate hazard mitigation methods (LIR 402-600-01, Attachment D, "Electrical Hazard Assessment Tables"). The work has been assigned to seven categories based on the degree and type of electrical energy present, and three modes based on the operational status of the equipment or system.

6.3 Hazard Mitigation

6.3.1 Guidance for Deenergized Electrical Work (Mode 1)

The following steps should be taken in Mode 1:

- Use an approved deenergizing procedure (for example, LIR 402-860-01, "Lockout/Tagout for Personal Safety") to deenergize electrical equipment.
 - The first consideration for working on any electrical system is to make certain that the circuit is positively deenergized. Consider all circuits and equipment energized until they have been disconnected, locked, and tagged according to an approved deenergization procedure. When the possibility exists that another source could energize a circuit or when capacitive devices (including cables) could retain or build up a charge, ground and short the circuit or cables.
 - Determine safe procedures for deenergizing circuits and equipment before attempting deenergization. The deenergization procedures should be included in the lockout/tagout procedure for the circuit or equipment to be deenergized.

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- Whenever work is to be performed on a positively deenergized system, opportunities for accidental contact with exposed energized parts in the vicinity of the work should be identified and suitable protection should be provided.
- Verify the deenergized condition.
 - A qualified worker should verify that all live circuits and parts and other sources of energy (electrical or mechanical) have been disconnected, released, or are restrained. Use test equipment to test the circuit elements and electrical parts of equipment to which personnel will be exposed and verify that the circuit elements and equipment parts are deenergized. An alternative method of verification is visually inspecting to ascertain whether grounding or shorting conductors or the disconnecting means are adequately sized. The verification should also determine whether any energized condition exists as a result of inadvertently induced voltage or unrelated voltage backfeed after specific parts of the circuit have been deenergized. The test should be conducted as though the circuit were energized.
 - If the circuit to be tested normally operates at voltages greater than 50 V, it should be determined whether the test equipment is operating as designed immediately before and immediately after the verification test. All test equipment should be rated for the system voltage, transient overvoltage exposure, and application.
 - Capacitors and high-energy-capacitance elements, such as cables and transformers, should be safely discharged, short-circuited, and grounded if the stored electric energy could endanger personnel. A stored-energy level of 10 Joules or greater should be considered dangerous.
 - Devices that could reenergize electric circuit parts should be blocked or relieved to prevent circuit parts from energizing accidentally. Specific examples should include wound springs and pneumatically driven devices.

6.3.2 Guidance for Electrical Diagnostics and Testing (Mode 2)

Qualified workers performing electrical diagnostics and testing on energized electrical systems, parts, or equipment should

- before beginning work, know the content of the work and review the sequence to be followed in accomplishing the work.
- identify the safety procedures that are to be followed.
- perform diagnostics and tests on energized circuits only if qualified or if being trained under the direct supervision of a qualified person.
- in a hazardous situation or condition, perform diagnostics and tests using either the two-person rule or a safety watch, as directed in Attachment D of LIR 402-600-01.
- notify all individuals who are involved in the work of any changes in the work conditions.
- document approval to perform diagnostics and tests on energized electrical systems or equipment by obtaining supervisor approval of a standard operating procedure (SOP), special electrical work permit (SEWP), or hazard control plan (HCP).
- for lockout/tagout, verify that zero voltage is Mode 2 work. For facility work on systems of 600 V or less, no additional procedure beyond LIR 402-860-01 should be required.
- perform diagnostics and tests on energized electrical equipment only if a qualified supervisor and the qualified personnel performing the work determine that the work can be completed safely using the 100% rule.
- use required personal protective equipment (PPE).
- ensure that conductive articles of jewelry, clothing, and materials that might come in contact

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- with energized parts are not worn or carried.
- ensure required illumination and remove obstructions in enclosures, junction boxes, and electrical installations to provide a clear view of the electrical work being performed.
- when any unsafe condition develops, immediately stop diagnostics and tests and report the condition to your immediate supervisor for resolution before continuing work.
- ensure that tools and instruments are in good working order and are up-to-date calibrated as required.
- limit access to the work area to authorized individuals who are familiar with the work and do not allow unauthorized individuals to enter the work area.
- deenergize exposed equipment when leaving the area.
- be alert at all times to situations in which personnel are working near exposed energized parts that could create unexpected electrical hazards.

6.3.3 Guidance for Energized Electrical Work (Mode 3)

Qualified workers performing electrical repairs, modifications, or other work on energized electrical systems, parts, or equipment should

- before beginning work, know the content of the work and review the sequence to be followed in accomplishing the work.
- know the safety procedures for the work being performed.
- ensure required illumination and remove obstructions in enclosures, junction boxes, and electrical installations to provide a clear view of the electrical work being performed.
- when any unsafe condition develops, immediately stop work and report the condition to the immediate supervisor for resolution before continuing work.
- ensure that tools and instruments are in good working order and are up-to-date calibrated.
- limit access to the work area only to authorized individuals who are familiar with the work and do not allow unauthorized individuals to enter the work area.
- use required PPE.
- put up barriers, shield exposed conductors, and otherwise secure a safe condition when leaving the area.
- be alert at all times to situations in which personnel are working near exposed energized parts that could create electrical hazards.

6.4 Electrical Worker Training

6.4.1 Implementation Guidance

Line management has the responsibility for determining that a worker is qualified to perform specific electrical work and to authorize the work. The following guidance is provided to assist managers in this duty.

The qualifications necessary to perform energized electrical work should consist of three elements: education, training, and experience.

Attachment B contains forms that safety-responsible line managers can use for recording energized and nonenergized electrical workers' qualifications, including education, experience, and training. Remember that it is possible for a person to be qualified to use certain equipment and methods but still be unqualified to use others.

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6.4.1.1 Education

Electrical workers should

- have an associate degree in an electrical field;
- have completed a recognized, apprenticeship program of at least 4 years; or
- have the equivalent combination of academic and relevant work background.

6.4.1.2 Training

Training should be documented and should include both classroom and OJT in the specific job duties, HCPs, SOPs, and safe work practices relevant to the job duties.

Establishing worker training plans helps ensure that workers receive the initial and refresher training required to maintain their status as a qualified worker. Training plan status and course completion can be tracked through the Employee Development System (EDS), the Laboratory's official training record database.

Refresher training on relevant codes, equipment, operations or procedures, and safe work practices should be completed at the frequency indicated in the applicable training plan or when job duties or working conditions change.

Documented equivalent training completed at other locations may be substituted for some LANL classroom training if it is acceptable to the LANL chief electrical safety officer.

OJT provides the skills, techniques, and work practices and/or procedures required to work safely on the specific equipment or task at hand. Required OJT should be listed in an HCP, SOP, or SEWP. One of the main purposes of OJT should be to enable the worker to recognize and avoid the electrical hazards that might be present with respect to equipment, work methods, or the work site. OJT should follow a graded approach that reflects the complexity and degree of hazard associated with the tasks. All OJT should be documented.

6.4.1.3 Experience

Four years of applicable work experience is recommended.

6.4.2 Classroom Training Plans

The classroom training plans in Attachment C are provided as guidance to assist safety-responsible line managers in assigning their workers to the required core electrical safety training. For additional assistance in determining training, see the electrical hazard assessment tables in Attachment D of LIR 402-600-01. Safety-responsible line managers may create specialized training plans to address job descriptions not covered in Attachment C; specialized training plans should be tracked in the EDS. The terms "required" and "suggested" in the training plans in Attachment C are taken from the EDS and are used in this LIG for consistency.

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6.4.3 On-the-Job Training

OJT for electrical workers should be developed, implemented, and documented following the guidance in LIG 300-00-04, "Laboratory Training: Graded and Systematic Approach to On-the-Job Training." The following table provides guidance for a graded approach for OJT, relating the class and mode of electrical work from the electrical hazard assessment tables in LIG 402-600.01 to the OJT levels described in LIG 300-00-04.

GRADED APPROACH TO ON-THE-JOB TRAINING FOR ELECTRICAL WORKERS

	Classes 1.1 and 2.1	Classes 1.2 and 2.2	Classes 1.3 and 2.3	Class 1.4
Mode 1: Deenergized and checked	Level 1 OJT is optional.	Level 1 OJT is optional.	Level 2 OJT	Level 3 OJT
Mode 2: Diagnostics and Testing	Level 1 OJT is optional.	Level 1 OJT	Level 3 OJT	Level 3 OJT
Mode 3: Energized	Level 1 OJT is optional.	Level 2 OJT	Level 3 OJT	Level 3 OJT

OJT trainers may be any of the following who are qualified and experienced in using the procedure and equipment and know the environment associated with the work: supervisor, subject matter expert (SME), electrical safety officer.

6.5 Approval of Unlisted Equipment

6.5.1 General

Under LIR 402-600.01, ESOs are responsible for approving unlisted electrical equipment under their authority as safe for its intended use. Before giving approval, the ESO should examine the equipment item and specify the limits of the environment in which it may be safely used. The inspection of equipment for safety should be prioritized to match the level of residual risk of the equipment under review, and inspections should include the analysis and input of the designer, manufacturer, or an appropriate SME. The approval may remain in force through changes in ESOs and organization names, as long as the equipment item continues to be used as specified in the approval and any new ESO agrees with the approval. The approval of unlisted equipment described in this section applies to equipment installed and used at LANL but does not apply to equipment intended for use elsewhere.

6.5.2 Listed Equipment

Listed equipment meets nationally recognized standards and has been examined for safety and published in a list by a nationally recognized testing laboratory (NRTL). A list of NRTLs acceptable to the LANL electrical AHJ can be found at <http://www.osha-slc.gov/dts/otpca/nrtl/index.html>.

Note: None of the European or Asian standards organizations is included in the list of acceptable NRTLs.

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6.5.3 Liability Issues

ESOs have the basic duty not to act, or fail to act, negligently. Under California law reflected in the prime contract between DOE and the University, the Laboratory will defend University of California employees for actions they have taken within the scope of their employment...except in cases where the employee acted or failed to act because of fraud, corruption, or malice. Note that the Laboratory has no obligation to defend employees of lower-tier subcontractors—employees of lower-tier subcontractors should check with their own employers about liability issues associated with ESO duties.

6.5.4 Equipment Approval Process

The flowchart in Attachment D is recommended as a guide for the ESO to use through the equipment approval process and for determining the course of action for a particular electrical equipment item. For assistance in implementing the “prioritize using risk analysis” box, the instructions for the Checklist for Approval of Unlisted Equipment form in Attachment D and Section 8 in LIR 300.00-01, “Safe Work Practices,” should be referred to. Further assistance can be obtained by contacting ESH-5.

6.5.5. Equipment Approval Checklist

Attachment D contains an equipment approval checklist that the ESO may use for the field inspection of unlisted electrical equipment. The checklist contains references to help the ESO determine the applicability of a particular National Electrical Code article to the equipment under review.

6.5.6 Labeling Approved Equipment

Attachment D also includes a label that ESOs can use to identify approved electrical equipment. The label provides information about the ownership, review, and approval of the equipment. Labels are available from ESH-5.

6.5.7 Tagging Unsafe Equipment

If an inspection reveals that an equipment item is unsafe for its intended use, the ESO should remove the equipment item from service and tag it as “DEFECTIVE” “OUT OF SERVICE.” Such tags are standard products available from commercial sources. The ESO should indicate on the tag the date of the inspection and the planned disposition of the equipment (such as “repair” or “salvage”).

6.5.8 Documenting the Approval

An equipment approval database is available for use by all LANL ESOs. This database can be used as a place to list equipment that has been approved, and the “comments” field can be used to record information about the limiting environment in which the equipment can be safely used. The database can also be used as a place to prioritize the equipment in the inventory of equipment awaiting approval. The equipment approval database is located at <https://remedy.lanl.gov/ESO/>.

The ESC should request the ESOs to send feedback about the applicability and ease of use of the database and possible improvements to sparks@lanl.gov.

6.5.9 Equipment from a “Nationally Recognized Source”

A “nationally recognized source” is a US manufacturer of electrical and electronic equipment who follows North American industry standards and produces quality products that are generally recognized as safe for their intended use. (The equipment approval database described above contains an initial roster of “nationally recognized sources.”) For economic reasons, some specifically limited-production equipment models from the nationally recognized source may not be NRTL- listed.

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To be approved in this category, the equipment item should not be modified and should be installed and used in accordance with the manufacturer's instructions. Detailed inspections and tests of such equipment are not usually required. Checking the following can ensure personnel safety:

- Is the case grounded through the power cord to the grounding pin on the plug?
- Is the plug polarized?
- Do the equipment input voltage and frequency match those of the building's electrical system?
- Is the equipment construction suitable for the intended operating environment?
- Is the equipment in its original, unmodified, and undamaged condition?
- If the equipment has externally accessible supplementary overcurrent protection (e.g., fuses), are properly sized fuses installed?

6.5.10 Equipment from a Non-US Source

Non-US manufacturers of electrical and electronic equipment, though they may produce quality products, generally follow different standards. Equipment modified so that it can work on standard US voltages may be unsafe. Such equipment should receive detailed inspections and tests.

6.5.11 Equipment in Continuous Use for at Least 5 Years

LANL has thousands of pieces of unlisted, specially fabricated electrical equipment. Much of this equipment has been in continuous use for more than 5 years with an excellent safety record. The LANL equipment approval process should focus on that equipment where the risks are higher or presently indeterminate. Therefore, the LANL Electrical Safety Program has adopted a risk-based approach to effectively address equipment approval and avoid directing resources toward minimal risk activities.

As stated in LIR 402-600-01.1, Section 7.6.1, "Unlisted equipment procured, designed, assembled, fabricated, or manufactured at the Laboratory prior to October 1, 1999, and in continuous use for at least 5 years prior to that date with no known accidents or incidents, shall be considered "approved," unless an ESO specifically requires an examination for safety or disapproves such equipment." Equipment that has been in continuous use for more than 5 years without a safety-related incident has a high probability of presenting an acceptably low risk to trained LANL employees, based on one or more of the following considerations:

- LANL's unlisted electrical equipment was designed and fabricated by expert-level, technically competent staff and technicians. In many cases, competent industrial suppliers fabricated the equipment. Fabrication by experts and/or by industry greatly reduces the risk that design errors that might cause a catastrophic or critical injury will remain undetected in the equipment.
- During testing and commissioning, the electrical equipment was used over its full range of operation for extended periods with extensive diagnostics in place. Testing and commissioning greatly reduces the risk that hazards associated with equipment evaluation Criteria #1 through #6 in Attachment D will remain undetected in the equipment.
- Equipment that has been used once per day for 5 years without incident has a probability of incident of 0.08% or less; this fits one of the definitions of "improbable" likelihood in LIG 300-00-01. If the equipment is used more than once per day the probability is reduced. If there are many similar or identical pieces of equipment that have been used without incident for 5 years, the likelihood is reduced even further—maybe even to "remote."

The above considerations point to a "low" or "minimal" expected risk for the vast majority of the legacy LANL equipment that has been in continuous use for more than 5 years. Since trained workers use this equipment, often operating under an HCP or SEWP that provides additional procedural hazard

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controls, the residual risk of using this legacy equipment is reduced to an acceptable level. Therefore, unless the ESO has concerns about the safety of particular pieces of equipment, unlisted equipment that has been in continuous use for more than five years without a safety-related incident may be approved without detailed examination.

The equipment approval checklist in Attachment D provides a space for recording information about personnel familiar with the history of an equipment item that has been in use for at least five years without a safety-related incident.

7.0 REFERENCES

7.1 Document Ownership

The office of institutional coordination for this document is the Industrial Hygiene and Safety Group (ESH-5).

7.2 Electrical Requirements Documents

LIR 402-600-01.1, "Electrical Safety."

7.3 Related Documents

LIR 300-00-01, "Safe Work Practices."

LIG 300-00-04, "Laboratory Training: Graded and Systematic Approach to On-the-Job Training."

8.0 ATTACHMENTS

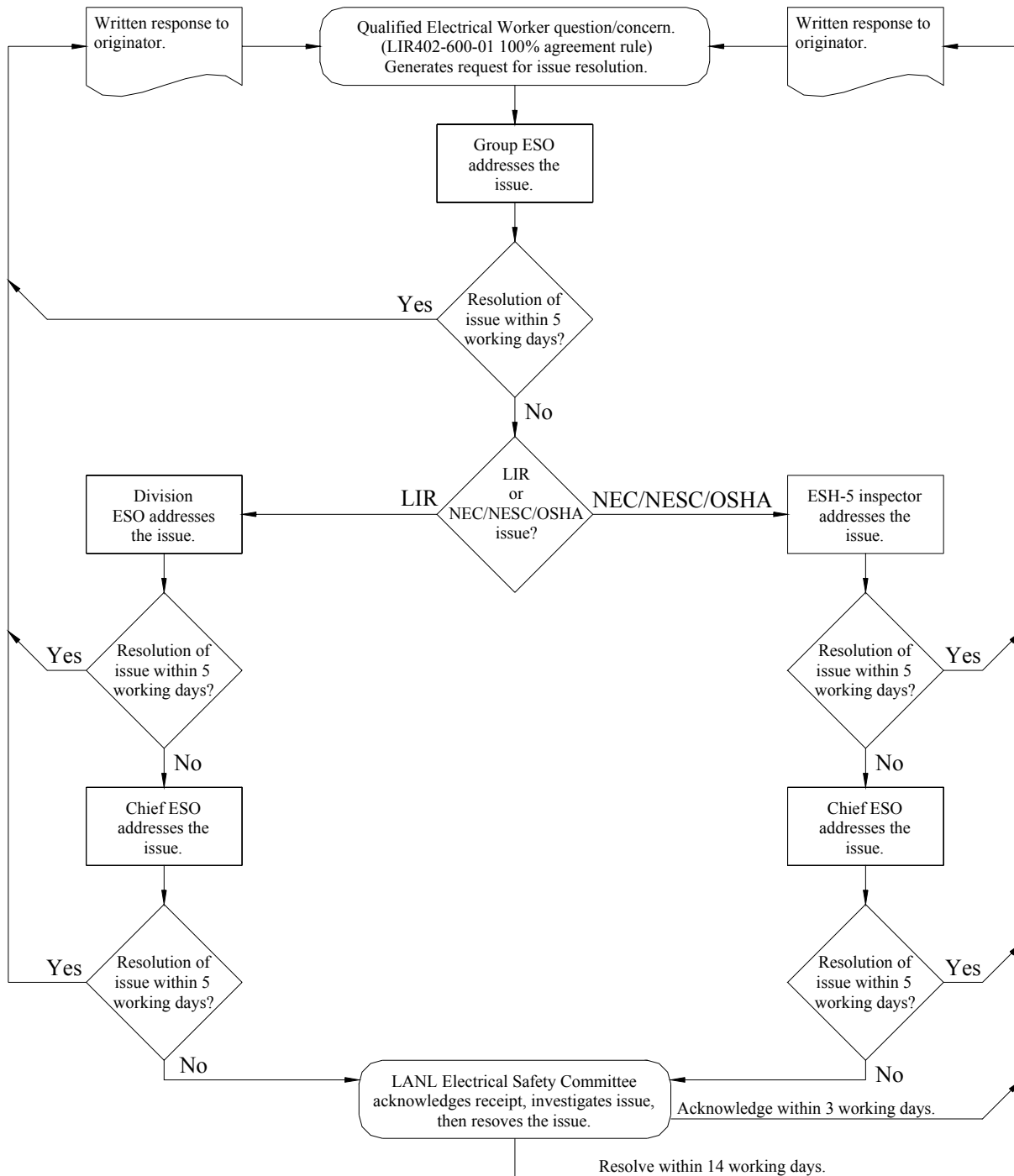
The following attachments contain flow charts and forms that are recommended for use in the implementation of the Electrical Safety Program:

- Attachment A "Recommended Process for Resolution of Electrical Safety Issues"
- Attachment B "Guidance for Individuals Qualified to Perform Energized Electrical Work"
- Attachment C "Classroom Training Plans"
- Attachment D "Recommended Process for Approval of Unlisted Equipment"
- Attachment E ["Electrical Safety Guidance Bulletins \(Click Here\)"](#)

ATTACHMENT A

Recommended

Process for Resolution of Electrical Safety Issue



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LANL ELECTRICAL SAFETY PROGRAM ISSUE RESOLUTION PROCESS

Date Initiated _____

Initiated by _____ Group _____

Description of Issue _____

Reference LIR _____ NEC _____
 NESC _____ OSHA _____
 Other _____

Summary of facts (attach additional information if necessary).

Resolution Process (See flow chart in LIG Attachment A)	Date Received	Date Resolved	Date Forwarded	Date Initiator Notified*
Group ESO Name:				
Division ESO Name:				
ESH-5 Electrical Inspector Name:				
Chief ESO				
Electrical Safety Committee				

*Send a copy of this form to the initiator as notification that issue is resolved or forwarded to the next level.

Resolution of issue (attach additional information if necessary).

Resolved by _____ (Signature)

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ATTACHMENT B

GUIDANCE FOR INDIVIDUALS QUALIFIED TO PERFORM ENERGIZED ELECTRICAL WORK

Employee _____

Z-number _____ Group _____ Mail Stop _____ Phone _____

Job description _____

A qualified energized electrical worker is anyone whose supervisor has determined to have the skill, knowledge, and abilities to perform safely the work to which he/she is assigned. The qualifications required to perform energized electrical work should consist of three elements: education, training, and work experience. In addition to the core Laboratory-wide electrical safety training, OJT on the HCPs, SOPs, and SEWPs and on the R&D or facility equipment required to complete each job or duty are also necessary. A person can be considered qualified with respect to certain equipment and methods but still be unqualified for others.

I. General Qualifications

1. Education (list courses or degrees relevant to energized electrical work).

2. Work Experience (list experience relevant to energized electrical work).

3. Electrical Safety Training Plan (assign one) Individuals trained to this guidance are qualified to perform safety watch or the second-person-rule duties.

- ☐ R&D Electrical Workers Energized Using Lockout/Tagout
- ☐ R&D Electrical Workers Energized NOT Using Lockout/Tagout
- ☐ Electricians/Apprentice Electricians
- ☐ Nonelectrician Crafts Energized
- ☐ Linemen and Utility Engineers
- ☐ Electrical Designers / Electrical Engineers Energized
- ☐ Supervisors Authorize Electrical Work
- ☐ Electrical Safety Officer

Complete both sides of this form.

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II. Job-Specific Training on Equipment or Procedures

Each job or task that involves energized electrical work requires OJT on the specific equipment or procedures required to perform the job. OJT is an instructional method whereby workers obtain job-specific knowledge and skills in the work environment. OJT should follow a graded approach that reflects the complexity and degree of hazard associated with the tasks. Refer to LIG 402-600-01 for guidance in assigning OJT levels based on the hazard class and mode of the electrical work; refer to LIG 300-00-04 for guidance in implementing OJT using a graded approach.

1. HCP or SOP training for job or task (list task or duty).

List all required HCPs or SOPs and check off when completed.

- | | |
|--------------------------------|--------------------------------|
| <input type="checkbox"/> _____ | <input type="checkbox"/> _____ |
| <input type="checkbox"/> _____ | <input type="checkbox"/> _____ |
| <input type="checkbox"/> _____ | <input type="checkbox"/> _____ |

2. HCP or SOP Training for Job or Task (list task or duty)

List all required HCPs or SOPs and check off when completed.

- | | |
|--------------------------------|--------------------------------|
| <input type="checkbox"/> _____ | <input type="checkbox"/> _____ |
| <input type="checkbox"/> _____ | <input type="checkbox"/> _____ |
| <input type="checkbox"/> _____ | <input type="checkbox"/> _____ |

3. HCP or SOP Training for Job or Task (list task or duty)

List all required HCPs or SOPs and check off when completed.

- | | |
|--------------------------------|--------------------------------|
| <input type="checkbox"/> _____ | <input type="checkbox"/> _____ |
| <input type="checkbox"/> _____ | <input type="checkbox"/> _____ |

Submitted	Date	Reviewed	Date	Approved	Date
Employee Signature		ESO Signature		Supervisor Signature	

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GUIDANCE FOR INDIVIDUALS QUALIFIED TO PERFORM DEENERGIZED ELECTRICAL WORK

Employee _____

Z-number _____ Group _____ Mail Stop _____ Phone _____

Job description _____

Individuals who work on deenergized systems need electrical safety training but not to the extent needed by those who work on energized systems. Supervisors need to determine whether the worker has the skill, knowledge, and abilities to perform safely the work to which he/she is assigned. The qualifications required to perform electrical work on deenergized systems and components consist of three elements: *education, training, and work experience*. In addition to the core Laboratory electrical safety training, OJT for the HCPs and SOPs relevant to each job or duty may also be required.

I. General Qualifications

1. Education (if relevant to deenergized electrical work)

2. Work Experience (list details relevant to deenergized electrical work)

3. Electrical Safety Training Plan (assign one)

(Individuals trained to this guidance are not qualified to perform safety watch or the second-person-rule duties.)

- ☐ R&D Electrical Workers Nonenergized
- ☐ Electronic/Computer Technicians Nonenergized
- ☐ Electrical Designers/Electrical Engineers Nonenergized
- ☐ Crafts Worker Nonenergized/Nonelectrical
- ☐ General Workers Electrical Hazards
- ☐ Supervisors Authorize Electrical Work

Complete both sides of this form

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II. Equipment and Procedures Qualifications

Some deenergized electrical work may require OJT on the specific equipment or procedures required to perform the job. OJT training should be documented.

HCP or SOP Training for Job or Task (list task or duty).

List any required HCPs or SOPs and check off when completed.

<input type="checkbox"/> _____	<input type="checkbox"/> _____
<input type="checkbox"/> _____	<input type="checkbox"/> _____
<input type="checkbox"/> _____	<input type="checkbox"/> _____

III. Job-Specific Training on Equipment and Procedures

Each job or task that involves energized electrical work requires OJT on the specific equipment and procedures required to perform the job. OJT is an instructional method by which workers obtain job-specific knowledge and skills in the work environment. OJT should follow a graded approach that reflects the complexity and degree of hazard associated with the tasks. Refer to LIG 402-600-01 for guidance in assigning OJT levels based on the hazard class and mode of the electrical work; refer to LIG 300-00-04 for guidance in implementing OJT using a graded approach.

1. HCP or SOP Training for Job or Task (list task or duty).

List all required HCPs or SOPs and check off when completed.

<input type="checkbox"/> _____	<input type="checkbox"/> _____
<input type="checkbox"/> _____	<input type="checkbox"/> _____
<input type="checkbox"/> _____	<input type="checkbox"/> _____

2. HCP or SOP Training for Job or Task (list task or duty)

List all required HCPs or SOPs and check off when completed.

<input type="checkbox"/> _____	<input type="checkbox"/> _____
<input type="checkbox"/> _____	<input type="checkbox"/> _____
<input type="checkbox"/> _____	<input type="checkbox"/> _____

Submitted	Date	Reviewed	Date	Approved	Date
Employee Signature		ESO Signature		Supervisor Signature	

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ATTACHMENT C

CLASSROOM TRAINING PLANS

Note: The terms “required” and “suggested” in the headers of the tables in the training plans in this attachment come from the EDS and are used in this LIG for consistency. These training plans are provided for guidance—whether to use this guidance is up to the electrical worker’s safety-responsible line manager.

Training Plan Title: R&D Electrical Workers: Energized Using Lockout/Tagout

Assignment Code/Training Plan: 359/2876

Training Plan Description

This training is for researchers, technicians, scientists, engineers, or other personnel who perform or approve work on energized electrical components, equipment, and circuits in an R&D environment. This work includes diagnostics and testing, repair, and/or replacement work in Classes 2.2 and 2.3. These workers may be authorized to use lockout/tagout as described in LIR 402-860-01, “Lockout/Tagout for Personal Safety,” to control hazardous energy when performing work.

Implementation: This training plan becomes effective October 1, 1999.

EDS #	Course Title	Frequency of Training	Required/Suggested	Equivalent EDS #	Equivalent Course Title
16750	LANL Electrical Safety Program	36 months	Required	11627	Electrical Safety in the R&D Laboratory
16749	Electrical Injury Mechanisms	Once	Required	11627	Electrical Safety in the R&D Laboratory
16822*	Electrical Elective (Choose one or more appropriate courses from the 2-hour electives.)	36 months	Required	11627	Electrical Safety in the R&D Laboratory
				16749	Electrical Injury Mechanisms
				16748	Radio Frequency and Microwave Safety (elective)
				16747	Pulsed Power Safety (elective)
				16746	Computer Safety (elective)
				16745	Batteries and Battery Bank Safety (elective)
				16744	Basic Facility Wiring Principles (elective)
				16743	Basics of R&D Grounding and Shielding (elective)
				16742	Introduction to Electrical Theory (elective)

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EDS #	Course Title	Frequency of Training	Required/Suggested	Equivalent EDS #	Equivalent Course Title
				16751	Designing Safe Electrical Equipment (elective)
				17554	Test and Measurement Safe Work Practices (elective)
3583	CPR: Adult	Once	Required	3582	CPR: Community
				12180	CPR: Two Person
				12925	CPR: Adult Equivalent
				13076	Adult CPR/Two Person
13408*	CPR: Adult Retraining (prerequisite—EDS #3583 or equivalent listed above)	12 months	Required	3583	CPR: Adult (or equivalent course listed above)
				13169	CPR Review and Challenge
				16585	CPR Refresher—2 hours
17719	LANL Lockout/Tagout Procedures	Once	Required	24859 and 23664	LANL LOTO Hands-On Training and LANL LOTO Procedures WBT
23664	LANL Lockout/Tagout Procedures WBT	24 months	Required	17719	LANL Lockout/Tagout Procedures
17744	Protective Measures for Hazardous Electrical Systems	24 months	Suggested		NA
16520	Understanding the R&D/NEC Interface	36 months	Suggested		NA
25970	Orange Lock LOTO Procedures (Self-Study)	Once	Suggested		NA

*Courses listed as equivalent to the indicated EDS course number satisfy the elective named.

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Training Plan Title: R&D Electrical Workers: Energized NOT Using Lockout/Tagout

Assignment Code/Training Plan 775/4044

Training Plan Description

This training is for researchers, technicians, scientists, engineers, or other personnel who perform or approve work on energized electrical components, equipment, and circuits in an R&D environment. This work includes diagnostics and testing, repair, and/or replacement work in Classes 2.2 and 2.3. Personnel who do this work use ESO-approved and management-authorized methods to control hazardous energy. If workers will be authorized to use lockout/tagout, then Training Plan 2876 applies instead of this training plan.

Special Guidance Note: The safety-and-environment responsible line manager/supervisor should determine whether LIR 402-860-01, "Lockout/Tagout for Personal Safety" is applicable to the components, equipment, and circuits to which these workers are exposed while performing work. The safety-and-environment responsible line manager/supervisor for each worker should ensure that the methods used to control hazardous energy (cord and plug control, engineering control, and/or administrative control) provide the required level of personal safety.

Implementation: This training plan will be available September 1, 1999 and becomes effective October 1, 1999. Workers should complete EDS #17744, "Protective Measures for Hazardous Electrical Systems", before transferring to this plan.

EDS #	Course Title	Frequency of Training	Required/Suggested	Equivalent EDS #	Equivalent Course Title
16750	LANL Electrical Safety Program	36 months	Required	11627	Electrical Safety in the R&D Laboratory
16749	Electrical Injury Mechanisms	Once	Required	11627	Electrical Safety in the R&D Laboratory
16822*	Electrical Elective (Choose one or more appropriate courses from the 2-hour electives.)	36 months	Required	11627	Electrical Safety in the R&D Laboratory
				16749	Electrical Injury Mechanisms
				16748	Radio Frequency and Microwave Safety (elective)
				16747	Pulsed Power Safety (elective)
				16746	Computer Safety (elective)
				16745	Batteries and Battery Bank Safety (elective)
				16744	Basic Facility Wiring Principles (elective)
				16743	Basics of R&D Grounding and Shielding (elective)
				16742	Introduction to Electrical Theory (elective)
				16751	Designing Safe Electrical Equipment (elective)

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EDS #	Course Title	Frequency of Training	Required/Suggested	Equivalent EDS #	Equivalent Course Title
				17554	Test and Measurement Safe Work Practices (elective)
3583	CPR: Adult	Once	Required	3582	CPR: Community
				12180	CPR: Two Person
				12925	CPR: Adult Equivalent
				13076	Adult CPR/Two Person
13408*	CPR: Adult Retraining (prerequisite—EDS #3583 or equivalent listed above)	12 months	Required	3583	CPR: Adult (or equivalent course listed above)
				13169	CPR, Review and Challenge
				16585	CPR Refresher—2 hours
17744	Protective Measures for Hazardous Electrical Systems	24 months	Required		None
17719	LANL Lockout/Tagout Procedures	Once	Suggested	24859 and 23664	LANL LOTO Hands-On Training and LANL LOTO Procedures WBT
23664	LANL LOTO Procedures WBT	24 months	Suggested	17719	LANL LOTO Procedures
16520	Understanding the R&D/NEC Interface	36 months	Suggested		NA
25970	Orange Lock LOTO Procedures (Self-Study)	Once	Suggested		NA

*Courses listed as equivalent to the indicated EDS course number satisfy the elective named.

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Training Plan Title: Electricians/Apprentice Electricians

Assignment Code/Training Plan: 194/2559

Training Plan Description

This training is for journeyman and apprentice electricians who perform or approve diagnostics and testing and/or repair and replacement work on energized electrical equipment, systems, and circuits in Classes 1.2 and 1.3.

Implementation This training plan becomes effective January 4, 2000.

EDS #	Course Title	Frequency of Training	Required/Suggested	Equivalent EDS #	Equivalent Course Title
10997	LANL Electrical Safety Program for Electrical Crafts	36 months	Required	16750	LANL Electrical Safety Program
3583	CPR: Adult	Once	Required	3582	CPR: Community
				12180	CPR: Two Person
				12925	CPR: Adult Equivalent
				13076	Adult CPR/Two Person
13408*	CPR: Adult Retraining (prerequisite—EDS #3583 or equivalent listed above)	12 months	Required	3583	CPR: Adult (or equivalent course listed above)
				13169	CPR Review and Challenge
				16585	CPR Refresher—2 hours
17719	LANL Lockout/Tagout Procedures	Once	Required	24859 and 23664	LANL LOTO Hands-On Training and LANL LOTO Procedures WBT
23664	LANL LOTO Procedures WBT	24 months	Required	17719	LANL Lockout/Tagout Procedures
16520	Understanding the R&D/NEC Interface (20hour course)	36 months	Required	12035	National Electrical Code 1996
17999	1999 NEC Changes (12-hour course; available January 4, 2000)	36 months	Required	12035	National Electrical Code 1996
				16283	Analysis of the 1999 NEC Changes (available until January 4, 2000)

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EDS #	Course Title	Frequency of Training	Required/Suggested	Equivalent EDS #	Equivalent Course Title
18363*	Facility Electrical Elective (Choose one or more appropriate courses from the electives listed to the right)	36 months	Required	12035	National Electrical Code 1996
				16283	Analysis of the 1999 NEC Changes (available until January 4, 2000)
				18002	Transformers (8-hour elective; available January 18, 2000)
				18001	Motors and Generators (16-hour elective; available February 2, 2000)
				18003	System and Equipment Grounding (16-hour elective; available January 4, 2000)
				18000	Electrical Calculations (8-hour elective; available January 11, 2000)
				17998	Facility Engineering Electrical Standards (8-hour elective available February 11, 2000)
17554	Test and Measurement Safe Work Practices	36 months	Suggested		NA
25970	Orange Lock LOTO Procedures (Self-Study)	Once	Suggested		NA

*Courses listed as equivalent to the indicated EDS course number satisfy the elective named.

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Training Plan Title: Nonelectrician Crafts: Energized

Assignment Code/Training Plan: 363/2908

Training Plan Description

This training is for nonelectrician craft workers (such as refrigeration pipe fitters, welders, and modular furniture installers) who perform or approve diagnostics and testing and/or repair and replacement work on energized electrical equipment, systems, and circuits.

Implementation: This training plan becomes effective October 1, 1999.

EDS #	Course Title	Frequency of Training	Required/Suggested	Equivalent EDS #	Equivalent Course Title
10997	LANL Electrical Safety Program for Electrical Crafts	36 months	Required	16750	LANL Electrical Safety Program
3583	CPR: Adult	Once	Required	3582	CPR: Community
				12180	CPR: Two Person
				12925	CPR: Adult Equivalent
				13076	Adult CPR/2-Person
13408*	CPR: Adult Retraining (prerequisite—EDS #3583 or equivalent listed above)	12 months	Required	3583	CPR: Adult (or equivalent course listed above)
				13169	CPR Review and Challenge
				16585	CPR: Refresher —2 hours
17719	LANL Lockout/Tagout Procedures	Once	Required	24859 and 23664	LANL LOTO Hands-On Training and LANL LOTO Procedures WBT
23664	LANL LOTO Procedures WBT	24 months	Required	17719	LANL Lockout/Tagout Procedures
17554	Test and Measurement Safe Work Practices	36 months	Suggested		NA
25970	Orange Lock LOTO Procedures (Self-Study)	Once	Suggested		NA

*Courses listed as equivalent to the indicated EDS course number satisfy the elective named.

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Training Plan Title: Linemen & Utility Engineers

Assignment Code/Training Plan: 364/2911

Training Plan Description

This training is for linemen and utility electrical designers and engineers who perform or approve work on or near medium-voltage or high-voltage (greater than 600 volts) energized electrical systems, Class 1.4.

Implementation

This training plan becomes effective January 4, 2000. Workers should have completed EDS #3574, "First Aid Standard," before that date.

EDS #	Course Title	Frequency of Training	Required/Suggested	Equivalent EDS #	Equivalent Course Title
16750	LANL Electrical Safety Program	36 months	Suggested	11627	Electrical Safety in the R&D Laboratory
				10997	LANL Electrical Safety Program for Electrical Crafts
9502	National Electrical Safety Code	36 months	Suggested		None
12632	Transmission and Distribution Electrical Safety	36 months	Suggested		None
17719	LANL Lockout/Tagout Procedures	Once	Suggested	24859 and 23664	LANL LOTO Hands-On Training and LANL LOTO Procedures WBT
23664	LANL LOTO Procedures WBT	24 months	Suggested	17719	LANL Lockout/Tagout Procedures
12180	CPR: Two Person	12 months	Required		None
3574	First-Aid Standard	36 months	Required		None
17554	Test and Measurement Safe Work Practices	36 months	Suggested		NA
25970	Orange Lock LOTO Procedures (Self-Study)	Once	Suggested		NA

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Training Plan Title: Electrical Designers/Electrical Engineers: Energized

Assignment Code/Training Plan: 295/2912

Training Plan Description

This training is for electrical designers and electrical engineers who perform or approve energized work, Classes 1.2, 1.3, 2.2, and 2.3.

Implementation

This training plan becomes effective January 4, 2000. Workers should have completed EDS #17744, "Protective Measures for Hazardous Electrical Systems," before that date.

EDS #	Course Title	Frequency of Training	Required/Suggested	Equivalent EDS #	Equivalent Course Title
16750	LANL Electrical Safety Program	36 months	Required	11627	Electrical Safety in the R&D Laboratory
16749	Electrical Injury Mechanisms	Once	Required	11627	Electrical Safety in the R&D Laboratory
16822*	Electrical Elective (Choose one or more appropriate courses from the 2-hour electives.)	36 months	Required	11627	Electrical Safety in the R&D Laboratory
				16749	Electrical Injury Mechanisms
				16748	Radio Frequency and Microwave Safety (elective)
				16747	Pulsed Power Safety (elective)
				16746	Computer Safety (elective)
				16745	Batteries and Battery Bank Safety (elective)
				16744	Basic Facility Wiring Principles (elective)
				16743	Basics of R&D Grounding and Shielding (elective)
				16742	Introduction to Electrical Theory (elective)
				16751	Designing Safe Electrical Equipment (elective)
				17554	Test and Measurement Safe Work Practices (elective)
3583	CPR: Adult	Once	Required	3582	CPR: Community
				12180	CPR: Two Person
				12925	CPR: Adult Equivalent
				13076	Adult CPR/2-Person

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EDS #	Course Title	Frequency of Training	Required/Suggested	Equivalent EDS #	Equivalent Course Title
13408*	CPR: Adult Retraining (prerequisite—EDS #3583 or equivalent listed above)	12 months	Required	3583	CPR: Adult (or equivalent course listed above)
				13169	CPR: Review and Challenge
				16585	CPR Refresher—2 hours
17719	LANL Lockout/Tagout Procedures	Once	Required	24859 and 23664	LANL LOTO Hands-On Training and LANL LOTO Procedures WBT
23664	LANL LOTO Procedures WBT	24 months	Required	17719	LANL Lockout/Tagout Procedures
17744	Protective Measures for Hazardous Electrical Systems	24 months	Required		None
9502	National Electrical Safety Code	36 months	Suggested		NA
12632	Transmission and Distribution Electrical Safety	36 months	Suggested		NA
16520	Understanding the R&D/ NEC Interface	36 months	Suggested		NA
17999	1999 NEC Changes	36 months	Suggested		NA
18363*	Facility Electrical Elective (Choose one or more appropriate courses from the electives listed to the right)	36 months	Suggested	18002	Transformers (8-hour elective)
				18001	Motors and Generators (8-hour elective)
				18003	System and Equipment Grounding (16-hour elective)
				18000	Electrical Calculations (8-hour elective)
				17998	Facility Engineering Electrical Standards (8-hour elective)
25970	Orange Lock LOTO Procedures (Self-Study)	Once	Suggested		NA

*Courses listed as equivalent to the indicated EDS course number satisfy the elective named.

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Training Plan Title: R&D Electrical Workers: Nonenergized

Assignment Code/Training Plan: 285/2899

Training Plan Description

This training is for individuals who perform or approve work on electrical equipment, Class 2.1 only.

Note: This training **DOES NOT** prepare these individuals to perform the second-person or safety-watch role.

Implementation: This training plan becomes effective October 1, 1999.

EDS #	Course Title	Frequency of Training	Required/Suggested	Equivalent EDS #	Equivalent Course Title
16750	LANL Electrical Safety Program	36 months	Required	11627	Electrical Safety in the R&D Laboratory
16749	Electrical Injury Mechanisms	Once	Required	11627	Electrical Safety in the R&D Laboratory
16822*	Electrical Elective (Choose one or more appropriate courses from the 2-hour electives.)	36 months	Required	11627	Electrical Safety in the R&D Laboratory
				16749	Electrical Injury Mechanisms
				16748	Radio Frequency and Microwave Safety (elective)
				16747	Pulsed Power Safety (elective)
				16746	Computer Safety (elective)
				16745	Batteries and Battery Bank Safety (elective)
				16744	Basic Facility Wiring Principles (elective)
				16743	Basics of R&D Grounding and Shielding (elective)
				16742	Introduction to Electrical Theory (elective)
				16751	Designing Safe Electrical Equipment (elective)
				17554	Test and Measurement Safe Work Practices (elective)
3583	CPR: Adult	Once	Suggested		NA
13408	CPR: Adult Retraining (prerequisite—EDS #3583 or equivalent)	12 months	Suggested		NA
17719	LANL Lockout/Tagout Procedures	Once	Suggested	24859 and 23664	LANL LOTO Hands-On Training and LANL LOTO Procedures WBT

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EDS #	Course Title	Frequency of Training	Required/Suggested	Equivalent EDS #	Equivalent Course Title
23664	LANL LOTO Procedures WBT	24 months	Suggested	17719	LANL LOTO Procedures
17744	Protective Measures for Hazardous Electrical Systems	24 months	Suggested		NA
25970	Orange Lock LOTO Procedures (Self-Study)	Once	Suggested		NA

*Courses listed as equivalent to the indicated EDS course number satisfy the elective named.

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Training Plan Title: Electronic/Computer Technicians: Nonenergized

Assignment Code/Training Plan: 362/2913

Training Plan Description

This training is for individuals who perform or approve work on electrical equipment that either operates at less than 50 volts or has been deenergized. These employees are at risk of exposure to electrical hazards due to the removal of protective barriers, but these workers do not perform energized electrical work.

Note This training **DOES NOT** prepare these individuals to perform the second-person or safety-watch role.

Implementation: This training plan becomes effective October 1, 1999.

EDS #	Course Title	Frequency of Training	Required/Suggested	Equivalent EDS #	Equivalent Course Title
16750	LANL Electrical Safety Program	36 months	Required	11627	Electrical Safety in the R&D Laboratory
16749	Electrical Injury Mechanisms	Once	Required	11627	Electrical Safety in the R&D Laboratory
16822*	Electrical Elective (Choose one or more appropriate courses from the 2-hour electives.)	36 months	Required	11627	Electrical Safety in the R&D Laboratory
				16749	Electrical Injury Mechanisms
				16748	Radio Frequency and Microwave Safety (elective)
				16747	Pulsed Power Safety (elective)
				16746	Computer Safety (elective)
				16745	Batteries and Battery Bank Safety (elective)
				16744	Basic Facility Wiring Principles (elective)
				16743	Basics of R&D Grounding and Shielding (elective)
				16742	Introduction to Electrical Theory (elective)
				16751	Designing Safe Electrical Equipment (elective)
				17554	Test and Measurement Safe Work Practices (elective)
3583	CPR: Adult	Once	Suggested		NA
13408	CPR: Adult Retraining (prerequisite—EDS #3583 or equivalent)	12 months	Suggested		NA

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EDS #	Course Title	Frequency of Training	Required/Suggested	Equivalent EDS #	Equivalent Course Title
17719	LANL Lockout/Tagout Procedures	Once	Suggested	24859 and 23664	LANL LOTO Hands-On Training and LANL LOTO Procedures WBT
23664	LANL LOTO Procedures WBT	24 months	Suggested	17719	LANL LOTO Procedures
17744	Protective Measures for Hazardous Electrical Systems	24 months	Suggested		NA
25970	Orange Lock LOTO Procedures (Self-Study)	Once	Suggested		NA

*Courses listed as equivalent to the indicated EDS course number satisfy the elective named.

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Training Plan Title: Electrical Designers/Electrical Engineers: Nonenergized

Assignment Code/Training Plan: 367/2954

Training Plan Description

This training is for electrical designers and electrical engineers who do not perform energized work.

Implementation: This training plan becomes effective October 1, 1999.

EDS #	Course Title	Frequency of Training	Required/Suggested	Equivalent EDS #	Equivalent Course Title
16750	LANL Electrical Safety Program	36 months	Required	11627	Electrical Safety in the R&D Laboratory
16749	Electrical Injury Mechanisms	Once	Required	11627	Electrical Safety in the R&D Laboratory
16822*	Electrical Elective (Choose one or more appropriate courses from the 2-hour electives.)	36 months	Required	11627	Electrical Safety in the R&D Laboratory
				16749	Electrical Injury Mechanisms
				16748	Radio Frequency and Microwave Safety (elective)
				16747	Pulsed Power Safety (elective)
				16746	Computer Safety (elective)
				16745	Batteries and Battery Bank Safety (elective)
				16744	Basic Facility Wiring Principles (elective)
				16743	Basics of R&D Grounding and Shielding (elective)
				16742	Introduction to Electrical Theory (elective)
				16751	Designing Safe Electrical Equipment (elective)
				17554	Test and Measurement Safe Work Practices (elective)
3583	CPR: Adult	Once	Suggested		NA
13408	CPR: Adult Retraining (prerequisite—EDS #3583 or equivalent)	12 months	Suggested		NA
17719	LANL Lockout/Tagout Procedures	Once	Suggested	24859 and 23664	LANL LOTO Hands-On Training and LANL LOTO Procedures WBT
23664	LANL LOTO Procedures WBT	24 months	Suggested	17719	LANL LOTO Procedures

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Laboratory Implementation Guide, LIG 402-600-01.2

Issue Date 12/24/96 (Revision Date: 06/5/2003)

Nonmandatory Document

EDS #	Course Title	Frequency of Training	Required/Suggested	Equivalent EDS #	Equivalent Course Title
17744	Protective Measures for Hazardous Electrical Systems	24 months	Suggested		NA
9502	National Electrical Safety Code	36 months	Suggested		NA
12632	Transmission and Distribution Electrical Safety	36 months	Suggested		NA
16520	Understanding the R&D/ NEC Interface (20-hour course)	36 months	Suggested		NA
17999	1999 NEC Changes (12-hour course)	36 months	Suggested		NA
18363*	Facility Electrical Elective (Choose one or more appropriate courses from the electives listed to the right)	36 months	Suggested	18002	Transformers (8-hour elective)
				18001	Motors and Generators (8-hour elective)
				18003	System and Equipment Grounding (16-hour elective)
				18000	Electrical Calculations (8-hour elective)
				17998	Facility Engineering Electrical Standards (8-hour elective)
25970	Orange Lock LOTO Procedures (Self-Study)	Once	Suggested		NA

*Courses listed as equivalent to the indicated EDS course number satisfy the elective named.

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Training Plan Title: Crafts Worker: Non-energized/Non-electrical

Assignment Code/Training Plan: 360/2909

Training Plan Description

This training is for crafts workers and laborers who risk exposure to electrical hazards but who do not work on electrical components or circuits. This includes riggers, construction workers, painters, plumbers, masons, sheet-metal workers, power-plant operators, operating engineers, roofers, machinists, and custodians.

Implementation: This training plan becomes effective October 1, 1999.

EDS #	Course Title	Frequency of Training	Required/Suggested	Equivalent EDS #	Equivalent Course Title
12175	LANL Electrical Safety Program for Non-Electrical Crafts	36 months	Required	10997	LANL Electrical Safety Program for Electrical Crafts
				11627	Electrical Safety in the R&D Laboratory
				16750	LANL Electrical Safety Program
3583	CPR: Adult	Once	Suggested		NA
13408	CPR: Adult Retraining (prerequisite—EDS #3583 or equivalent)	12 months	Suggested		NA
17719	LANL Lockout/Tagout Procedures	Once	Suggested	24859 and 23664	LANL LOTO Hands-On Training and LANL LOTO Procedures WBT
23664	LANL LOTO Procedures WBT	24 months	Suggested	17719	LANL LOTO Procedures
25970	Orange Lock LOTO Procedures (Self-Study)	Once	Suggested		NA

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Training Plan Title: General Workers: Electrical Hazards

Assignment Code/Training Plan: 372/2914

Training Plan Description

This training is for any individuals whom the safety-and-environment responsible line manager/supervisor identifies as being at risk of exposure to electrical hazards due to their job duties.

Note: Using computer workstations, coffeepots, copiers, or NRTL-approved electrical equipment does not usually place workers at risk.

Implementation: This training plan becomes effective October 1, 1999.

EDS #	Course Title	Frequency of Training	Required/Suggested	Equivalent EDS #	Equivalent Course Title
11516	Electrical Safety Basics (self-study)	36 months	Required	16750	LANL Electrical Safety Program
				11627	Electrical Safety in the R&D Laboratory
				12175	LANL Electrical Safety Program for Nonelectrical Crafts
				10997	LANL Electrical Safety Program for Electrical Crafts
3583	CPR: Adult	Once	Suggested		NA
13408	CPR: Adult Retraining (prerequisite—EDS #3583 or equivalent)	12 months	Suggested		NA

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Training Plan Title: Supervisors: Authorize Electrical Work

Assignment Code/Training Plan: 371/2915

Training Plan Description

This training is for safety-and-environment responsible line manager/supervisors who are responsible for authorizing both energized and non-energized electrical work.

Implementation: This training plan becomes effective October 1, 1999.

EDS #	Course Title	Frequency of Training	Required/Suggested	Equivalent EDS #	Equivalent Course Title
16750	LANL Electrical Safety Program	36 months	Required	11627	Electrical Safety in the R&D Laboratory
16749	Electrical Injury Mechanisms	Once	Required	11627	Electrical Safety in the R&D Laboratory
16822*	Electrical Elective (Choose one or more appropriate courses from the 2-hour electives.)	36 months	Required	11627	Electrical Safety in the R&D Laboratory
				16749	Electrical Injury Mechanisms
				16748	Radio Frequency and Microwave Safety (elective)
				16747	Pulsed Power Safety (elective)
				16746	Computer Safety (elective)
				16745	Batteries and Battery Bank Safety (elective)
				16744	Basic Facility Wiring Principles (elective)
				16743	Basics of R&D Grounding and Shielding (elective)
				16742	Introduction to Electrical Theory (elective)
				16751	Designing Safe Electrical Equipment (elective)
				17554	Test and Measurement Safe Work Practices (elective)
23664	LANL LOTO Procedures WBT	24 months	Required	17719	LANL Lockout/Tagout Procedures

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EDS #	Course Title	Frequency of Training	Required/ Suggested	Equivalent EDS #	Equivalent Course Title
24859	LANL LOTO Hands-On Training	Once	Suggested		
17744	Protective Measures for Hazardous Electrical Systems	24 months	Suggested		NA
3583	CPR:Adult	Once	Suggested		NA
13408	CPR: Adult Retraining (prerequisite—EDS #3583 or equivalent)	12 months	Suggested		NA
8878	Managing ES&H (self-study)	Once	Suggested		NA
25970	Orange Lock LOTO Procedures (Self-Study)	Once	Suggested		NA

*Courses listed as equivalent to the indicated EDS course number satisfy the elective named.

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Training Plan Title: Electrical Safety Officer

Assignment Code/Training Plan: 400/2959

Training Plan Description

This training is for group, division, or chief electrical safety officers.

Implementation

This training plan becomes effective January 4, 2000. Workers should have completed EDS #17744, "Protective Measures for Hazardous Electrical Systems," before that date.

EDS #	Course Title	Frequency of Training	Required/Suggested	Equivalent EDS #	Equivalent Course Title
16750	LANL Electrical Safety Program	36 months	Required	11627	Electrical Safety in the R&D Laboratory
16749	Electrical Injury Mechanisms	Once	Required	11627	Electrical Safety in the R&D Laboratory
16822*	Electrical Elective (Choose one or more appropriate courses from the 2-hour electives.)	36 months	Required	11627	Electrical Safety in the R&D Laboratory
				16749	Electrical Injury Mechanisms
				16748	Radio Frequency and Microwave Safety (elective)
				16747	Pulsed Power Safety (elective)
				16746	Computer Safety (elective)
				16745	Batteries and Battery Bank Safety (elective)
				16744	Basic Facility Wiring Principles (elective)
				16743	Basics of R&D Grounding and Shielding (elective)
				16742	Introduction to Electrical Theory (elective)
				16751	Designing Safe Electrical Equipment (elective)
				17554	Test and Measurement Safe Work Practices (elective)
17744	Protective Measures for Hazardous Electrical Systems	24 months	Required		None
17719	LANL Lockout/Tagout Procedures	Once	Required	24859 and 23664	LANL LOTO Hand-On Training and LANL LOTO Procedures WBT

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EDS #	Course Title	Frequency of Training	Required/Suggested	Equivalent EDS #	Equivalent Course Title
23664	LANL LOTO Procedures WBT	24 months	Required	17719	LANL Lockout/Tagout Procedures
12569	Electrical Codes for Electrical Safety Officers	36 months	Required		None
3583	CPR: Adult	Once	Suggested		NA
13408	CPR: Adult Retraining (prerequisite—EDS #3583 or equivalent)	12 months	Suggested		NA
11610	Managing Electrical Safety Introduction	Once	Suggested		NA
16520	Understanding the R&D/ NEC Interface (20-hour course)	36 months	Suggested		NA
17999	1999 NEC Changes (12-hour course)	36 months	Suggested		NA
18363*	Facility Electrical Elective (Choose one or more appropriate courses from the electives listed to the right)	36 months	Suggested	18002	Transformers (8-hour elective)
				18001	Motors and Generators (8-hour elective)
				18003	System and Equipment Grounding (16-hour elective)
				18000	Electrical Calculations (8-hour elective)
				17998	Facility Engineering Electrical Standards (8-hour elective)

*Courses listed as equivalent to the indicated EDS course number satisfy the elective named.

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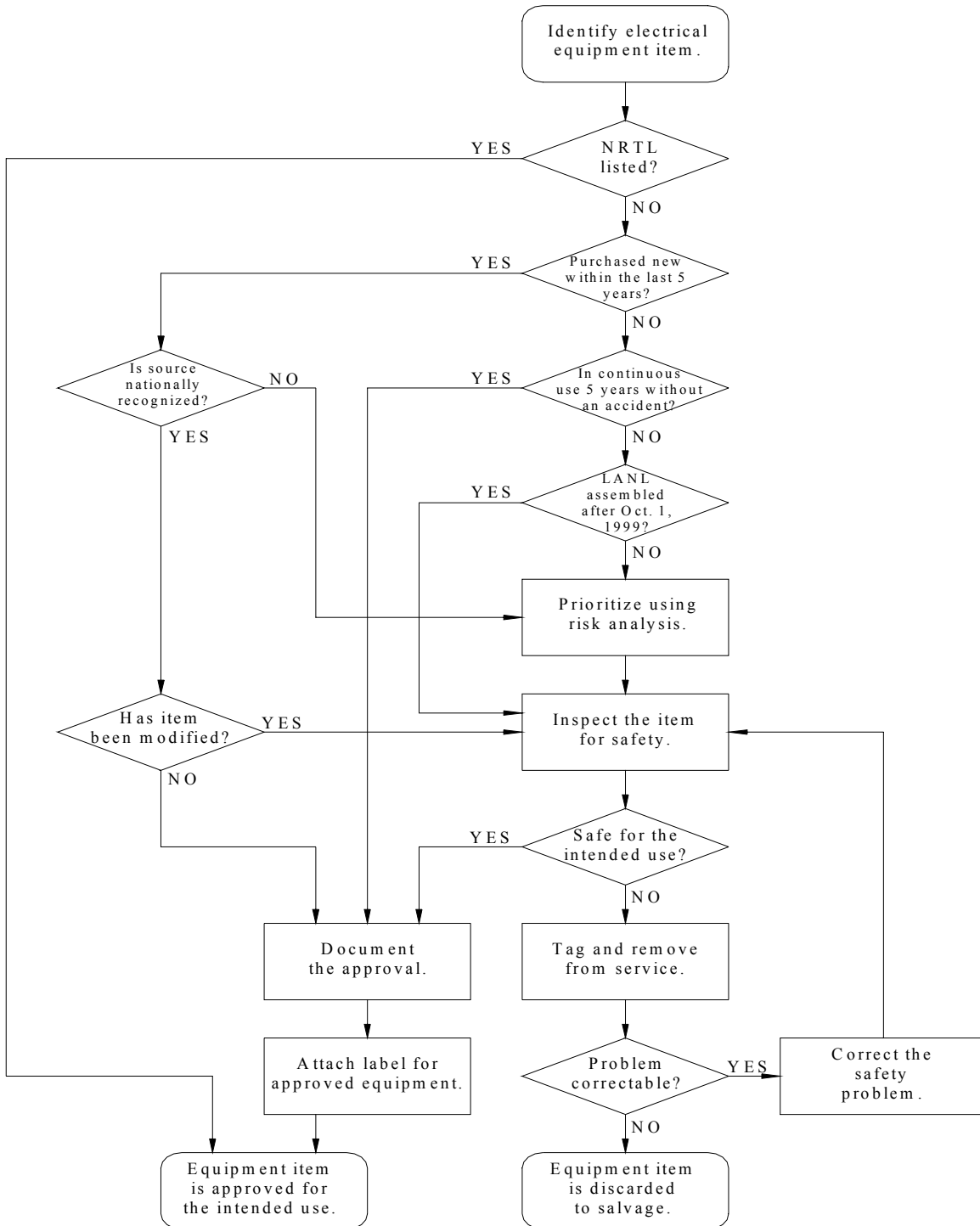
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ATTACHMENT D

RECOMMENDED

PROCESS FOR APPROVAL OF UNLISTED EQUIPMENT



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APPROVAL OF UNLISTED ELECTRICAL EQUIPMENT

File No. _____

SECTION 1 – EQUIPMENT DATA:			
Approval is for intended use within the approving organization only; refer to LIR 402-600-01, “Electrical Safety.”			
Group:	Responsible Person:		Z Number:
Equipment Description:			
Manufacturer:		Nationally Recognized Source: Yes <input type="checkbox"/> No <input type="checkbox"/>	
Model Number:			
Serial Number:		Property Number (if applicable):	
Status (check one): New <input type="checkbox"/> ; Modified <input type="checkbox"/> ; In use for 0 to 5 years <input type="checkbox"/> ; In use continuous use for over 5 years without incident <input type="checkbox"/> and attested by: _____ Z Number: _____ ; Other <input type="checkbox"/>			
Equipment Location:	TA:	Building:	Room:
If equipment is a system integrated for a defined use, list the subsystems:			

SECTION 2 – RISK ANALYSIS:	
Use a risk-based system to prioritize examination and approval; refer to LIR300-00-01, <i>Safe Work Practices</i> .	
Operational Importance (check one): Critical <input type="checkbox"/> ; Important <input type="checkbox"/> ; Not Necessary <input type="checkbox"/>	
Residual Risk (check one): High <input type="checkbox"/> (REMOVE FROM SERVICE); Medium <input type="checkbox"/> ; Low <input type="checkbox"/> ; Minimal <input type="checkbox"/>	
Evaluation Priority (see instructions, check one): High <input type="checkbox"/> ; Medium <input type="checkbox"/> ; Low <input type="checkbox"/>	

SECTION 3 – EVALUATION:			
Determine that electrical equipment is free from recognized hazards that are likely to cause death or serious physical harm to employees [29 CFR 1910.303 (b)]. Use the following factors when evaluating equipment [NEC 110-3 (a)]. See instructions for guidance.		Approved	Rejected
1	Suitability for installation and use in conformity with 29 CFR 1910 Subpart S and/or NEC.		
2	Mechanical strength and durability, including for parts designed to enclose and protect other equipment, the adequacy of the protection thus provided.		
3	Wire bending and connection space.		
4	Electrical insulation.		
5	Heating effects under normal conditions of use and also under abnormal conditions likely to arise in service.		
6	Arcing effects.		
7	Classification by type, size, voltage, current capacity, and specific use.		
8	Other factors that contribute to the practical safeguarding of persons using or likely to come in contact with the equipment, including non-electrical considerations and hazards.		

NOTE: APPROVED EQUIPMENT SHALL BE INSTALLED AND USED IN ACCORDANCE WITH THE INSTRUCTIONS PROVIDED BY THE DESIGNER/BUILDER OR ESO.

Comments: (Include all designer/builder instructions, restrictions on use, drawings or information that is relevant to the safe installation and use of this equipment. Attach additional sheets as necessary.)

- ☐ This equipment is approved for installation or use at LANL. IF THIS EQUIPMENT IS MODIFIED, RELOCATED, DAMAGED, REPAIRED OR UTILIZED FOR OTHER THAN THE INTENDED USE STATED ABOVE, THIS APPROVAL IS VOID, PENDING RE-EXAMINATION.
- ☐ This equipment is rejected for use at LANL. (See comments above.)

Date:	ESO Printed Name:	ESO Signature:
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INSTRUCTIONS/APPROVAL OF UNLISTED EQUIPMENT FORM

File Number—Develop a numbering system to track equipment approvals. (A suggested system consists of an alphanumeric designator composed of the user group's acronym followed by a dash and five numbers, e.g., DX4-00265.)

SECTION 1

Responsible Person—The “owner,” principal user, operator, or maintainer of the equipment item.

Status—The “In continuous use for over 5 years” status has space for recording the name and Z-number of the person who knows the history of the equipment; this may be the responsible person described above.

SECTION 2

Operational Importance—This is a judgment of the importance of the equipment to the facility or the mission.

Residual Risk—This is the output from the LIR 300-00-01 risk determination based on severity and likelihood.

- Equipment that operates within the following parameters can be considered as presenting very low hazard and can be exempted from this process:
 - Voltage greater than 50 V, current less than 5 milliamperes, and stored energy less than 10 joules.
 - Voltage less than 50 V and power less than 1000 watts.
- Equipment with high residual risk should be taken out of service immediately and either replaced or repaired to have an acceptable residual risk, after which it should be reinspected.

Evaluation Priority—A judgment of the order in which the equipment will be evaluated that is based on operational importance and residual risk as follows:

Residual Risk	OPERATIONAL IMPORTANCE		
	Critical	Important	Not Necessary
High	Remove from service	Remove from service	Remove from service
Medium	High	High	Medium
Low	Medium	Medium	Low
Minimal	Medium	Low	Low

SECTION 3

Item 1 Some potential considerations of suitability for installation and use are

- operation, considering the environmental conditions:
 - a) Temperature, humidity, altitude, nonionizing radiation (RF & EMI), ionizing radiation, outdoors, etc.
 - b) Normal and abnormal use, considering duty cycle, average and peak power, etc.

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- properly sized and installed equipment grounding (chassis grounding).
- equipment design that includes consideration of the available short circuit and ground fault current.
- properly sized and installed overcurrent protection (fuses or circuit breakers).
- separation of high and low voltage components, especially where high voltage could escape along a hidden fault path.

Note: See 1999 NEC 250-110, and 110-9.

Item 2 Mechanical strength and durability considerations include

- enclosure of parts to
 - a) prevent damage to internal components during use and transportation.
 - b) contain arcing, heating, and explosion.
 - c) prevent injury to personnel from hazardous energized parts.
 - d) prevent damage to internal components from environmental conditions.
- workmanship, e.g., check to see whether unused openings being effectively closed
- integrity of electrical equipment and connections.
- any item that would adversely affect the safe operation or mechanical strength of the equipment, such as damaged, corroded, or overheated parts.

Note: See 1999 NEC 110-12.

Item 3 Wire bending and connection space includes consideration of assembly and potential repair, based on the protection of conductors and their insulation against damage by overbending, overcrowding, location near moving parts in equipment and at termination points.

Note: See 1999 NEC 373-6 and tables 373-6(a) and (b).

Item 4 The integrity of insulation is paramount to ensure that the system or component:

- prevents the escape or transfer of electrical energy to other conductors or personnel,
- is free from short circuits or potential short circuits,
- uses listed conductors where possible, and
- is free from grounds other than those required or permitted by Article 250.

As a general rule, the ESO will require visual examination or insulation testing before accepting the system.

Note: See 1999 NEC 110-7

Item 5 Verify that conductors are installed and used in such a manner that normal listed or approved temperature ratings are not exceeded. If the condition of use in the R&D environment is substantially different from that anticipated in the product listing, have a subject matter expert determine that an appropriate level of safety is maintained. Also determine that exposed parts will burn personnel or initiate fires.

Note: See 1999 NEC 310-10, including the Fine-Print Note.

Item 6 Appropriate requirements for arcing effects include the following:

- If the equipment's ordinary operation produces arcs, sparks, flames, or molten metal, verify that it is enclosed or separated and isolated from all combustible material.

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- Verify that potential arc blast/electrical explosion are prevented from injuring personnel and damaging other equipment.

Note: See 1999 NEC 110-18.

Item 7 Verify that a permanent label is attached to the equipment that includes the following information:

- The manufacturer's (or LANL builder's) name or other descriptive marking by which the assembler, SME, reviewer, ESO, and the organization responsible for the equipment can be identified.
- Other markings should include the equipment voltage, current, wattage, and any additional wording that the ESO deems necessary for the safe operation of the equipment (e.g., type, size, power, stored energy, secondary hazards, specific use, and specific users).

Note: See 1999 NEC 110-21.

Item 8 Other factors contributing to practical safeguarding of personnel include

- reviewing nonelectrical hazards by appropriate subject matter experts.
- preventing electric shock, burn, or reflex hazards by eliminating personnel contact with potential hazards.
- ensuring that live parts of equipment operating at 50 volts or more should be protected from accidental contact by approved enclosures or by any of the following means:
 - a) by location in a box, enclosure, room, or vault that is accessible only to qualified persons.
 - b) by suitable permanent, substantial partitions or screens arranged so that only qualified persons have access to the space within reach of the live parts.
 - c) by location on a suitable balcony or platform elevated and arranged to exclude unqualified persons.
 - d) by elevation of 8 ft or more above the floor or other working surface.
- preparing a procedure of safing and energy removal, e.g., disconnection, lockout/tagout, removal of stored energy, for both normal/emergency shutdown.
- protecting eyes, skin, and equipment from UV and IR.
- protecting personnel and equipment from injury or interference from RF fields.
- preventing personnel exposure to excessive noise.
- preventing personnel exposure to X-rays that may emanate from equipment operating at above 15 kV, especially in a vacuum.
- using standard designs, including failsafe design:
 - a) use listed or recognized components, where possible.
 - b) use accepted color coding for wires, especially grounded (white or gray) and grounding conductors (bare or green).
 - c) consider loss of electrical power, pneumatic, etc.
 - d) consider automatic removal of stored energy.
 - e) consider the use of interlocks on enclosures and other systems.

Note: See 1999 NEC 110-27 and 110-31.

With careful planning and preparation, an ESO may be able to approve equipment that initially appears to be unsafe for use at the Laboratory. The ESO may suggest or make changes that enable such equipment to be approved.

The NEC articles listed for Items 1-8 above are only a partial list, which is meant to assist a qualified ESO in the equipment approval process. A working knowledge of the National Electrical Code is a

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prerequisite to starting the approval process. (Completion of the course, "Electrical Codes for Electrical Safety Officers," provides the ESO with only minimal working knowledge of the NEC.) Additional training and experience in use of the NEC may be necessary. Contact the Chief ESO at ESH-5 if you are not sure.) Technical assistance is available to any ESO who has questions regarding this procedure.

Because any equipment approved may be in use for an extended period of time, it is strongly advised that the approval process involve as much input from subject matter experts as the ESO deems necessary. Since the safety of Laboratory personnel, visitors, and the public are of primary importance, certain equipment approvals will require guidance by members of the scientific community at the Laboratory.

It is recognized that this approach requires time and that experience will increase during the learning period. At least initially, more complex approvals will almost certainly require a team effort.

NOTES TO ESOs

1. File this approval document in a permanent ESO-APPROVED EQUIPMENT file. Provide copies of this file to your group office and to the user of the equipment by attaching this document to the SOP, SEWP, or HCP. Other documentation (when available) may include
 - a) approval for specific uses, specific location(s), and specific purposes.
 - b) design specifications.
 - c) operating procedures, including safing procedures, and other SOPs, SEWPs, and HCPs.
2. Attach a label to the approved equipment that indicates the file number on this checklist, LANL division and group, responsible ESO, and the approval date. Refer to Attachment D in LIG 402-600-01.
3. Require the prompt disposal, disassembly, or removal of approval labels of any approved equipment that will no longer be used for its intended purpose. This will require periodic checks of the equipment.
4. Provide a detailed explanation of the approval to the end user. Explain that modifications of the equipment after the approval will necessitate repeating the approval process.
5. It is strongly suggested that equipment approvals involving complex issues be reviewed by the cognizant division ESO or the Laboratory's Chief ESO.

AVAILABLE RESOURCES

1. ESH-5 electrical inspectors
2. Scientists and engineers (subject matter experts)
3. Chief ESO
4. LANL Electrical Safety Committee

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LABEL FOR APPROVED EQUIPMENT

Refer to the notes below the label for an explanation of the information desired, as indicated on the label by the numbers in black.

ELECTRICAL SAFETY APPROVED	
File No. _____	1
Division / Group _____	2
ESO _____	3
Date _____	4
Approved for the intended use only within the approving organization. Refer to LIR 402-600-01.	
5	

Notes

1. Identifying number referencing equipment approval checklist and/or database entry. (Example DX4-00265 for item 265 in DX-4)
2. Organization that owns or uses the equipment item, either a LANL group or division.
3. Signature of the Electrical Safety Officer who approved the equipment item.
4. Date that the item equipment was approved.
5. Write-on, adhesive-backed Mylar label, approximately 2-1/4" x 1" with green shading. Label is available from ESH-5.